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INJECTION MOLDING OF PLASTICS PRODUCTS

A Manufacturing Possibility in Carroll County, Georgia

by

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Foreword

Injection molding of plastics products, a manufacturing operation particularly suited for development by local entrepreneurs or through diversification by existing manufacturers, is the subject of this final report on specific industrial growth opportunities in Carroll County. Like the four previous reports in this special series, this study is an outgrowth of an extensive analysis of the economic resources and development potentials of the county.

During the first 12 months of the over-all research and action program, detailed analyses were made of industrial sites, retail and wholesale trade, park and recreational facilities, established manufacturing operations, and basic economic resources of the seven incorporated cities in Carroll County. This groundwork was followed up in the second year by a series of product-industry studies, including -- in addition to this report -- a consideration of the county's potentials for developing or attracting facilities for producing wooden pallets, asphalt and vinyl asbestos floor tile, a variety of agriculturally oriented and wood-based products, and stainless steel food service equipment. This research effort was supplemented by five technical assistance projects designed to strengthen, expand, or diversify the manufacturing operations of established industrial firms in the county.

The objectives of the Area Redevelopment Administration "demonstration" project, of which this report is a part, are to increase employment opportunities and to boost the Carroll County economy through a three-year research-technical assistance-action program. Substantial results achieved during the first and second years demonstrate the practicality of the approach being used and presage the opportunities for even greater accomplishments from intensive follow-up action during the third year.

Comments or questions regarding this report or the over-all study are invited.

Kenneth C. Wagner, Chief
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Summary

A plant for proprietary and custom injection molding of consumer and industrial plastics products in Carroll County should net $23,800 (including interest paid) on sales of $300,000. Over-all return on a total capital investment of $150,000 would exceed 15%.

The rapidly growing plastics products industry is composed of a large number of small single-plant companies, with an average employment of 36. Injection-molding plants account for more than half of the total.

An injection-molding operation can be set up with relative ease. Capital requirements can total about $110,000, generous technical assistance is available from manufacturers and suppliers of raw materials, and most operating skills can be quickly and easily learned.

No company can expect to enjoy continued profitability and growth in this competitive industry, however, unless it has skilled management, especially in the areas of product innovation, high and continuously improving product quality, and aggressive sales promotion.

The operations required to produce plastics products by injection molding include (1) preparation of the molding material, (2) melting the material, (3) forcing the material through a nozzle and into a mold, (4) ejecting the molded part, and (5) machining and finishing the product.

There is a need for additional plastics products plants in the Southeast. Nine northern states plus California had 80% of all miscellaneous plastics products plants in 1958, while the seven-state area comprising Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee had only 4% of the plants. The seven-state area falls far short of adequately supplying its markets for plastics products, the sizes of which are roughly indicated by its portion of U. S. population (13.9%) and its share of manufacturing employment (11.3%). The disparity is attested by industry observers who state that custom-molded parts bring higher prices in the Southeast than they do in other regions.

From its position in the center of this large and growing seven-state market, Carroll County can offer the injection-molding industry access to well developed distribution and transportation facilities for shipping plastics

products. Among these is one- or two-day delivery on less-than-truckload shipments to a large part of the area.

The county can also offer an attractive labor supply. Farm labor and textile workers probably can be quickly retrained for the unskilled or semi-skilled jobs which prevail in plastics work. The county's labor relations record is another asset.

Carroll County entrepreneurs interested in the injection-molding industry should note that the mold designing and producing group which is growing in Atlanta cannot supply all of a plant's mold requirements at present. On the other hand, the variety of ways in which a company or group of individuals can grow into the industry makes it especially attractive for the area. An established company can begin by producing some of its own purchased parts from plastics or by producing complete plastic items related to its existing product lines. Another avenue of entry for a group of individuals is to contract with an existing processor to custom mold the desired products while it develops the new markets and distribution channels.

A company engaged in both proprietary and custom injection molding of consumer and industrial products valued at $300,000 can be established in Carroll County in a new building with a full range of new, high-quality equipment and adequate working capital for a total capital investment of approximately $170,000. About $110,000 of the total would be for fixed investment, a large part of which would be required for the three necessary injection-molding machines. Purchasing used equipment would lower investment, but would also bring a variety of problems. A sounder way to lower investment would be to lease or rent the 3,500-square-foot building instead of purchasing it. Investment would then total about $150,000.

Set up on a three-shift basis, the plant would require four production workers for each shift plus seven indirect labor, selling, and administrative personnel. Annual wages and salaries would total about $94,000. (See Table 2.)

The profit and loss statement projected for the Carroll County plant shows an annual profit of $15,800. (See Table 3.) Largest single cost is for direct materials and supplies. Excluding from selling, general, and administrative expense the $8,000 allocated for interest on borrowed capital (Table 5), the over-all return on investment would be $23,800.

INTRODUCTION

The large and rapidly growing plastics products industry has very little representation in the Southeast. Since plastics materials were originally substitutes for other materials, they were first introduced largely into those areas of the North with established manufacturing shops and technical experience. Because of the requirements and economics of the plastics products industry and the buying habits of its customers, there is a large number of small manufacturers today. They are still concentrated in the North, although California also has a substantial number.

Unlike most other industries, the plastics products industry has not established branch plants in the Southeast. In fact, the industry has very few branch plants anywhere, primarily because the typical individual company is too small and too concerned with day-to-day problems to consider the advantages of another plant location. The Southeast does appear to be a good location for plastics products manufacturing, however, principally because of its substantial markets and its attractive labor relations and costs.

There are two approaches which Carroll County can take to develop a plastics products industry. First, local entrepreneurs can set up plastics products operations, or existing manufacturers can diversify into a plastics products line. While this approach perhaps offers the most immediate opportunity, investment in new or additional plant facilities and production equipment should not be considered without first obtaining reasonably thorough technological knowledge of plant operations and plastics applications.

Second, local representatives can encourage existing manufacturers in the North and California to establish branch plants in Carroll County. Because of the preoccupation of most established manufacturers with operations in their present locations, this approach would require extensive preparation and fact finding in order to spark the interest of those companies which would profit from an expansion of production facilities into the southeastern market. If this approach were pursued, Carroll County's presentation should contain significant, well-documented advantages, not marginal or theoretical ones. Before a substantial plastics products industry could be attracted, for example, it would probably be necessary to train local workers in plastics technology at technical schools and colleges in the area.

This report is designed to be useful for both approaches. It provides a general picture of the costs involved in establishing and operating a small-scale plant for injection-molding plastics products in Carroll County. It should provide sufficient information to help developers, businessmen, and other local leaders determine whether or not the opportunities for this industry deserve more detailed attention. Plans for actual development and installation of a plant will require additional engineering and financial advice.

THE INJECTION-MOLDING INDUSTRY

The rapid growth of the plastics products industry accounts in part for its attractiveness to entrepreneurs. In 1938, suppliers to the fledgling plastics products industry produced 150 million pounds of synthetic resins and cellulosics. By 1954 the figure reached 2.9 billion pounds. In the next seven years shipments grew by 130% to 6.7 billion pounds.

The largest portion of recent consumption increases has been due to larger volume purchases of thermoplastics -- the materials used in injection molding. Since 1950, about half of the plastics products plants in the United States have used only injection-molding machinery; a second large portion of the total has used injection-molding plus compression or extrusion equipment.

Products and Characteristics of the Industry

A wide variety of plastics products, both industrial and consumer, are produced by injection molding. Largest industrial purchasers are the appliance, automotive, and building and construction industries, but injection-molded parts are also used in producer goods. Products shipped directly to consumer markets range from kitchenware to toys. Because of its many automatic features, the injection-molding process is generally used for small and medium-sized products with relatively high-volume production runs.

Like the rest of the plastics products industry, the injection-molding segment is composed of many small manufacturers. For example, 3,222 plants produced miscellaneous plastics products (SIC 3079) by all processes with a total value of nearly $1.9 billion in 1958. Shipments for the average plant were then $580,000. More than 2,000 of these plants had less than 20 employees, and the average employment was 36.

These 3,222 plants were operated by 3,093 companies, so very few companies have more than one plastics products plant. The large number of small single-plant companies indicates the ease of entry into the field.

An injection-molding plant can be established with about $110,000 total capital, including fixed capital of $50,000. Capital requirements may be less than indicated, since manufacturers of plastics processing machinery will arrange to finance purchases. Prospective customers may negotiate purchase contracts requiring a 10% down payment and allowing five years for payment of

the balance. Entrepreneurs are also offered generous technical assistance by manufacturers and suppliers of plastics resins. Further, most operating skills can be taught with relative ease, and most equipment can be used to produce a wide variety of products.

Because of the industry's rapid growth and the ease with which the field can be entered, many entrepreneurs find injection molding an attractive venture. Some may be further attracted by a large-volume contract to produce parts for a government project or large corporation, expecting to begin open competition with established producers when the contract has run out.

Ease of entry has made the plastics products industry severely competitive, however, with the result that skilled management and active sales promotion are essential to success.

Competition has resulted in a highly fragmented market in the case of consumer products with large national markets. The same product may be produced with seemingly infinite variations by many producers. Beginning with available raw materials, producers may select resins from some 20 major plastics groups, such as cellulosics, polyolefins, polyamides, and styrenes. Each of these groups contains a variety of materials with different properties, and each material may be sold in several forms which may produce different results in the final product. Still to be considered are such major variables as product design, finish, and dimensional stability. Any unpatentable variation which gives a price or appearance selling advantage to one producer is likely to be only temporary, since other producers can duplicate his advantage in a short time. Under such circumstances it is difficult for a single producer to hold a large part of the market.

Articles sold to a small group of customers, particularly industrial customers, will of course be made by fewer companies. But producers compete for markets on the bases of service, product quality, and precision, as well as price. A custom-molding company's established reputation plays an important role in determining whether or not it can successfully compete in this field.

No company can expect to enjoy continued profitability and growth in the highly competitive plastics products industry unless it has skilled management, especially in the areas of product innovation, high and continuously improving product quality, and aggressive sales promotion. The industry is

characterized by an increasing rate of new product development and constantly improving manufacturing and marketing techniques.

The properties possessed by plastics may be exploited through the development of entirely new products, through displacement of existing materials, and through the combination of plastics with other materials. Realization of potential industrial and consumer applications will require effort in research and development.

Successful production of consistently high-quality products will be dependent largely on company efforts to develop technical skill. The quality problem may also be attacked indirectly through technical innovations which reduce production labor costs, particularly in the finishing operations, thereby allowing time for improvements in quality while keeping prices competitive. Raw material and equipment manufacturers may also be sources of methods for quality improvements. Quality improvements which are dependent on the molds used may be effected by specialized mold makers hired by the injection molder or by the molder's own shop. In either case, however, they will be a direct result of the skill of the management of the injection-molding company.

In some product areas, product development has moved far ahead of market development. The firm able to open up channels for the flow of these products will be in an advantageous position as the growth of the plastics industry continues. In both consumer and industrial applications, major consumer education programs are needed. For example, markets for presently available construction applications could be rapidly expanded if builders, contractors, and public officials were aware of their advantages. Agricultural products have lagged far behind their present potential because of the slow development of these markets.

Manufacturing Operations

The operations required to produce plastics products by injection molding include (1) preparation of the molding material, (2) melting the material, (3) forcing the material through a nozzle and into a mold, (4) ejecting the molded product, and (5) machining and finishing the product. Operations 1 through 4 may be performed without interruption on a single combination of processing machinery.

Molding materials are frequently ready for immediate use when they are delivered by the supplier, but they may require pre-molding preparation. Plastic material fed to the injection machine must be reasonably free of moisture if internal voids and surface defects are to be avoided. Consequently, drying may be necessary to remove moisture from the surface of molding resins or, in the case of such hygroscopic materials as nylon, acrylics, and styrene blends, to drive out adsorbed water.

Pre-molding preparation may also require addition of colorants, lubricants, other resins, and scrap material which is to be reworked. These materials are generally blended into the virgin resin in some sort of tumbler.

After any necessary preparation, the molding material is transferred, either mechanically or manually, to a hopper which feeds the material to the heating cylinder of the injection-molding machine. Heat and mechanical agitation convert the cold, granular feed material into a homogeneous plastic melt of controlled viscosity. Temperature in the cylinder is controlled by wrap-around electrical resistance heaters. Mixing action is provided by forcing the melt past baffles or spreaders or by use of a rotating screw mechanism within the cylinder.

The plastic melt is forced through a nozzle and into the mold. Nozzle temperature is controlled to allow continued clean shots of plastic into the mold without hardening and breaking or drooling. The mold accepts a metered amount of plastic molding material and cools it quickly and uniformly, usually by transferring the heat to water or some other medium which is circulated through channels buried in the mold.

When the molding compound has set, the mold is opened and the molded part is forced out of the mold cavity. Some molded articles require some form of machining or finishing. Thermoplastics products can be machined with the same equipment used for wood or metals, except that allowance must be made for the greater heat sensitivity of the plastics product. They may be sawed, routed, drilled, turned, tapped, threaded, and sheared. Articles may be finished by buffing and polishing if surfaces are cooled or kept in constant motion, by tumble finishing, and by solvent polishing.

CARROLL COUNTY AS A LOCATION FOR AN INJECTION-MOLDING OPERATION

The Need for Additional Plants in the Southeast

Major plastics products producing states are Illinois, Massachusetts, New Jersey, New York, and Ohio in the Northeast and California in the West. Geographical dispersion of miscellaneous plastics products producing plants is much the same as it was in 1958, the year for which data are presented in Map 1. In that year, half of all the plants were in four states -- California, Illinois, New Jersey, and New York. These four states plus six others in the Northeast had more than 80% of all the plants. The southeastern area delineated in the map -- comprising Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee -- had only 4% of the plants.

Contrasting sharply with the seven-state area's portion of the plastics products industry are two rough indicators of markets for plastics products. The area had 13.9% of the U. S. population in 1960 and 11.3% of the manufacturing employment. Obviously the area falls far short of adequately supplying its markets for plastics products. The disparity is attested by industry observers who state that custom-molded parts bring higher prices in the Southeast than they do in other regions.

Advantages of a Carroll County Location

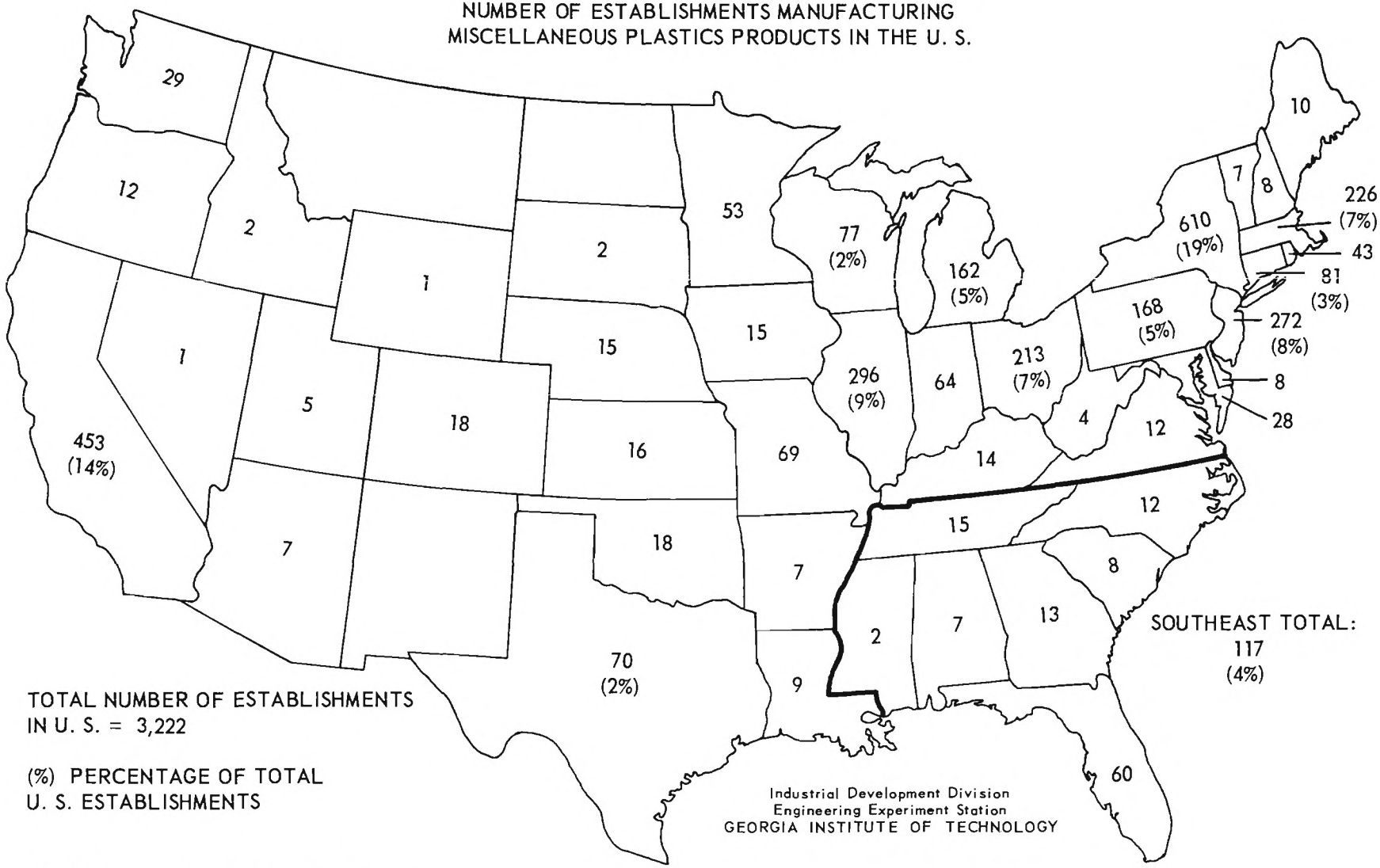
An injection-molding operation in Carroll County could serve the large and growing southeastern markets for many plastics products more adequately and at lower cost than existing suppliers in the Northeast. The county also has an attractive labor supply.

Transportation Facilities. Carroll County has access to well-developed distribution and transportation facilities for shipping plastics products. Consequently, an injection-molding operation in the area could offer rapid service and customer liaison.

The county is bisected by Interstate Highway 20, which connects with the southeastern system via such major interchange centers as Atlanta and Birmingham. Some 24 motor carriers have certificated interstate operating rights to transport "general commodities" with the "usual exceptions" directly from Carrollton. Transit times on direct less-than-truckload shipments from

MAP 1

NUMBER OF ESTABLISHMENTS MANUFACTURING
MISCELLANEOUS PLASTICS PRODUCTS IN THE U. S.



SOUTHEAST TOTAL:
117
(4%)

TOTAL NUMBER OF ESTABLISHMENTS
IN U. S. = 3,222

(%) PERCENTAGE OF TOTAL
U. S. ESTABLISHMENTS

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SOURCE: 1958 Census of Manufactures

Carrollton are approximately as shown on Map 2. First-morning delivery is provided to a large part of the Southeast; shipments to most remaining cities in the seven-state area will be delivered on the second morning after they are placed with the carrier. Delivery times to national markets also are favorable.

The Central of Georgia Railway and the Southern Railway System serve Carroll County and provide complete service, including Railway Express Agency service. Piggyback service to many cities in the Southeast is available at Atlanta and Cedartown. In addition, Carrollton has a paved, lighted airport. Most cities in the seven-state area with scheduled airline service can be reached from Atlanta in less than two hours flying time.

Located in the center of the Southeast, a Carroll County injection-molding operation obviously could ship to the seven-state market at less cost than northeastern manufacturers. Experience with freight savings analyses for similar products has shown that manufacturers who ship into the area from combinations of shipping points such as Chicago and New York can save up to 30% on freight bills for the region if they locate a shipping point in Georgia.

Labor Supply. In a recent audit and evaluation of manufacturing operations in Carroll County, over 90% of the manufacturers interviewed judged the local labor supply to be adequate to plentiful. The majority of these manufacturers also commented that the quality of labor was good or, in some cases, excellent. Specific traits mentioned most often were dependability, productivity, trainability, and good attitudes. At the time of the survey none of the manufacturing employees in the county were represented by a union.[1/]

The farm labor and textile workers which predominate in Carroll County probably can be quickly retrained for the unskilled or semi-skilled jobs which prevail in plastics work. In all of these industries, the worker sees and often touches and handles the product. This is in contrast to the chemical and petroleum refinery industries where the only contacts of many operators with the product are recording instruments, dials, and valves. The textile and plastics processing industries have further similarities. Production in

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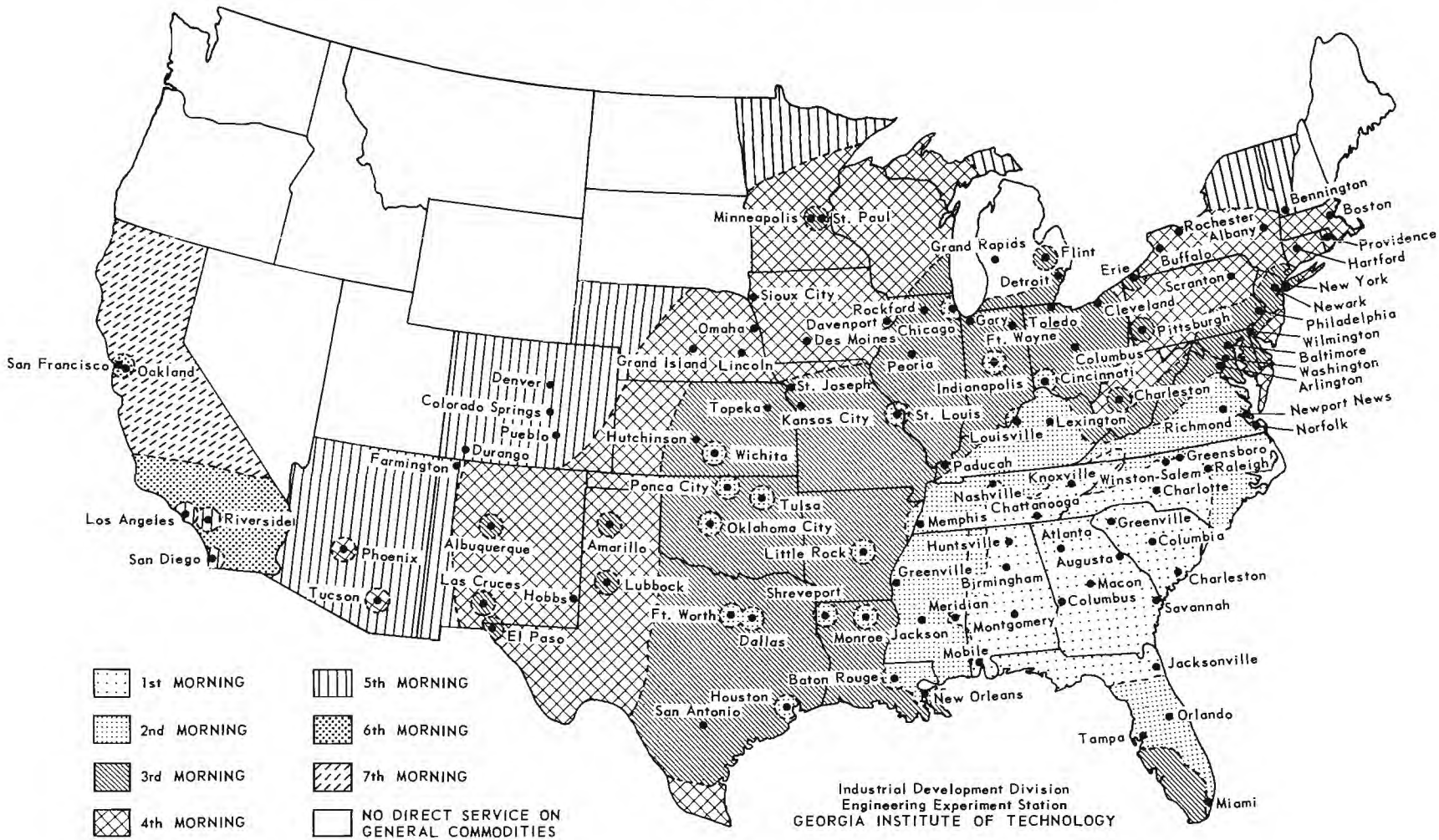
1/ M. Dale Henson and Robert H. McDonough, Audit and Evaluation of Manufacturing Operations in Carroll County, Georgia, Industrial Development Division, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Georgia, February 1963, p. 89.

MAP 2

TRANSIT TIMES ON DIRECT LESS-THAN-TRUCKLOAD SHIPMENTS

Base Point: Atlanta



both industries is by small units which work in parallel. In the textile industry it is by looms and spindles; in plastics processing it is by injection-molding machines and molds.

Adaptability of the Plastics Products Industry to Carroll County

In addition to considering the transportation and labor market advantages which Carroll County can offer the injection-molding industry, interested local industrialists should consider the attractions and problems of the industry, as discussed in the section of this report entitled "Products and Characteristics of the Industry," as they apply to the specific situation in Carroll County.

One problem not discussed there, because it is of a local nature, is the shortage of capability in mold design and production in the Southeast. A Carroll County manufacturer would have the advantage of easy access to the small mold designing and producing group which is growing in Atlanta, but would need to purchase some molds from other sections of the country.

The injection-molding industry also has the advantage of flexibility, which might appeal to some of the existing manufacturers in Carroll County. A company can grow into the injection-molding industry by producing some of its own purchased parts from plastics or by producing complete plastic items related to its existing product line. Eventually it can produce parts for other companies or new plastics products which are unrelated to existing product lines.

The injection-molding industry's flexibility will also be attractive to Carroll County entrepreneurs who wish to enter the industry without risking the investment in plant and equipment. If they do not have the necessary production skills, they can contract with an existing processor to custom mold the desired products while they develop the new markets and distribution channels. Most local injection molders are organized for this type of operation and are interested in serving distributors. After developing production skills through contact with the custom molder or after bringing individuals with production skills into the company, the established distributing company can set up its own manufacturing facilities in Carroll County.

REQUIREMENTS AND COST ESTIMATES FOR AN INJECTION-MOLDING OPERATION IN CARROLL COUNTY

Plant Capacity and Size

The manufacturing plant for which cost information is presented in this report is capable of producing $300,000 worth of injection-molded plastics products annually. It is both a custom and a proprietary shop -- the larger portion of the total sales is composed of negotiated contracts for a specified number and quality of products, while the smaller portion comprises sales of a limited number of products manufactured for stock and sold on demand to customers. Product mix may include both finished consumer items such as tableware, ash trays, toys, and beauty aids, and industrial parts such as clock cases, machine keys, gears, knobs, and handles. Most are likely to be sold to manufacturers and distributors, but some may be sold to wholesalers and retail chains and stores.

Such a sales volume and product mix can be produced in a plant comprising 3,500 square feet of floor space, including 3,000 square feet of production and storage area and 500 square feet of office space.

Capital Requirements

Capital requirements for establishing the operation in a new building with a full range of new, high-quality equipment and adequate working capital will total approximately $170,000, some $110,000 of which represents fixed capital requirements. Detailed allocation of the total is shown in Table 1. The three suggested injection-molding machines will allow efficient filling of molds ranging in capacity from 2½ to 20 ounces. At a total cost of about $60,000, they represent more than half of the total fixed investment and a third of the total capital required. The plant discussed does not have facilities for making molds.

Fixed capital requirements can be reduced by $18,500 if the 3,500-square-foot building is leased or rented. The resulting total capital requirement of about $150,000 is shown as an alternative in Table 1. An additional $40,000 reduction is possible if used ram-type injection-molding machines are purchased. The cost of three used ram-type machines (2½, 4, and 8 ounces) would be about $20,000 to $22,000, compared with $61,500 for the three new screw-type machines.

Table 1

CAPITAL REQUIREMENTS FOR AN INJECTION-MOLDING OPERATION
($300,000 annual production capacity)

Fixed Capital			
Land		$ 1,000	
Building -- 3,000 square feet plant and warehouse, 500 square feet office @ $5 per square foot		17,500	
Equipment, Fixtures, and Furniture			
Injection-molding machines:			
2½-ounce screw-type	$ 8,500		
4-ounce screw-type	18,000		
8-ounce screw-type	35,000	61,500	
Auxiliary equipment: Compressor, refrigeration system and temperature controllers for molds, atmospheric tower, grinders for scrap, tumbler, chain hoist, and other machining and auxiliary equipment		15,000	
Secondary equipment: Equipment for sawing, routing, turning, tapping, drilling, threading, and other machining and other finishing		3,000	
Installation: Installing equipment and wiring, pipe, and foundations associated with equipment		7,500	
Production and office furniture and fixtures		1,500	
Total Fixed Capital			$107,000
Working Capital			
Direct Materials (90 days)		$ 26,300	
Direct Labor (60 days)		7,200	
Other Manufacturing Expenses (60 days)		12,400	
Administrative and Sales Costs (30 days)		4,800	
Training Costs		5,000	
Contingencies		5,000	
Total Working Capital			60,700
TOTAL CAPITAL			$167,700
ALTERNATIVE TOTAL CAPITAL (see text)			$150,000

Purchasing such used equipment has several disadvantages, however. The upper limit of the operation's mold-filling capacity would be lowered to 8 ounces from the potential 20 ounces with new screw-type machines. More important, even a highly skilled engineer may not be able to evaluate the wear and operating conditions to which a machine has been subjected, so major repairs may be necessary after the machine has been operating only a short time. Also, most repair work is both time consuming and expensive for southeastern manufacturers, since the area still depends in part on northern areas for such service.

Manpower Requirements

Injection-molding plants are usually run on a three-shift basis, although instances of profitable two- and even one-shift operations can be cited. Set up on a three-shift basis, the plant under discussion would require four production workers for each shift plus seven indirect labor, selling, and administrative personnel. Annual wages and salaries for the necessary 19 employees would total $94,000.

The total, which includes shift and overtime premiums, is divided among 10 job titles in Table 2. Uniform shift premiums of 5¢ and 10¢ per hour for

Table 2

ANNUAL MANPOWER COSTS

Production Jobs	Number	Annual Cost 1/
Foreman-general operator	3	$13,000
General operator	6	21,000
Finisher-packer	3	9,000
	12	$43,000
Nonproduction Jobs		
General manager	1	$13,500 2/
Sales engineer	1	11,000 2/
Production manager-engineer	1	11,500
Shipping-receiving-cost control clerk	1	4,700
General secretary	1	2,900
Maintenance-general utility	1	5,000
Janitor-laborer-maintenance helper	1	2,400
	7	$51,000

1/ Includes shift premiums and overtime payments.

2/ Includes commissions.

the second and third shifts, respectively, are common in the plastic products industry and would be more than adequate in Carroll County. Overtime is likely to range between zero and 12 hours per week, with the average work week running about 45 hours; time and a half for weekdays and double time for Sundays and holidays are normal overtime premiums. Incentive-based wage plans are not common in the plastics industry; they are seldom used in southern plants.

Hourly earnings for production workers, including foremen-general operators, are projected in a range from $1.25 to $1.85, exclusive of shift and overtime premiums. Because only four production workers are scheduled per shift, each one must be able to perform a wide variety of jobs.

The foreman-general operator and the two general operators are each responsible for the feeding and operation of one injection-molding machine, as well as for the inspection and minor finishing of the machine's output. Their responsibilities may include blending specific amounts of various plastics molding powders and colorants, transporting the materials to the molding machine, and charging materials into the machine hopper. As injection-molding-machine operators their responsibilities include manipulating the controls which start the machine, liquefy the material in the heating chamber, inject molten material into the mold, cool the material in the mold, and eject the molded product. They may also position a variety of inserts in the mold cavity prior to molding, remove excess material from the molded object, perform minor finishing operations, and inspect the product for flaws and defects.

Since it is not possible for a single operator to discharge all of his responsibilities while keeping up with the continuous output of his machine, he will need assistance from the other operators and from the finisher-packer. On some occasions, one operator can keep up with the continuous output of two machines while the other prepares raw materials. Also, the finisher-packer can perform some of the operator's duties under the operator's supervision. The work load program for each shift should be flexible enough to allow for such cooperation. Of course, during the first and third shifts some of those employees designated as having nonproduction jobs can provide additional assistance. In addition, production workers can be called upon to work more than one shift when necessary.

The foreman-general operator will have responsibility for and authority over the other three production workers in his shift. These functions should

require only minor planning and paper work, however, since the foreman must perform all of the jobs of the general operator.

In addition to providing occasional assistance to the general operators, the finisher-packer will shape, finish, or assemble the molded plastics objects, inspect finished products for flaws and defects, and pack them for shipment. Repetitive, routine hand and machine operations may include buffing, drilling and tapping, filing, gluing, polishing, and sanding.

All three sales and management personnel should have technical backgrounds and a thorough knowledge of the applications of plastics in industrial and consumer goods. All three should devote some time to sales.

The duties of the general manager include general supervision of the various operations of the company, planning for methods and product improvements, and ultimate responsibility for purchasing equipment and major materials and supply items. He should devote a large part of his time to directing the sales effort and to participating in it. While it will be necessary for him to deal primarily with local customers and the company's proprietary products, he should also spend some time selling in the field and seeking custom-molding contracts.

The sales engineer should assist the general manager in developing new applications and sales programs, but he should devote most of his efforts to work in the field. Field duties include contacting potential customers, evaluating possible plastics applications, assisting customers in rough design of plastics products, roughly estimating prices, and providing continuing contacts and service to customers. In addition to his work with the general manager and his field work, the sales engineer should work with the production manager-engineer in firming up plastics products designs and contract prices.

The production manager-engineer should perform most product design work, prepare firm estimates for bidding on jobs, and prepare purchase requisitions for special materials required for particular jobs. He should be solely responsible for scheduling work and supervising the production force. In addition, he should supervise the maintenance workers, recommend methods improvements and new equipment installations, and implement those methods improvements and new equipment installations approved by the general manager.

The duties of the shipping-receiving-cost control clerk include preparing shipping orders and supervising loading and shipping of all products to customers.

He should prepare requisitions for and receive all materials and supplies, record materials used on shop orders, and make periodic test-counts of materials for comparison with perpetual records. As cost control clerk he should prepare work orders, maintain perpetual store records, prepare purchase orders, check vendors' invoices, cost and extend material requisitions and job cards, maintain payroll records, maintain work-in-progress and completed-jobs summaries and files, and prepare customers' invoices.

The general secretary, in addition to her duties for the three sales and management personnel, should assist the shipping-receiving-cost control clerk.

The duties of the maintenance-general utility man include keeping machines, mechanical equipment, and the plant in repair; installing, aligning, and balancing major parts and equipment; and building items such as bins and partitions. Performance of these duties will involve the use of tools and equipment of several trades. The maintenance-general utility man may also be called on to assist temporarily both production workers and nonproduction personnel. Because he should be on call for major breakdowns throughout the working day, his hours may be irregular; his normal work day should begin two hours before the day shift and extend six hours into the day shift.

Annual Costs and Profits

Annual costs and profits vary widely among injection-molding companies. Variations are due not only to the quality of management, but also to the product mix -- the proportions of consumer, industrial, proprietary, and custom-molded products.

Projected annual costs for an injection-molding plant in Carroll County are presented in Table 3. The statement is supplemented with Tables 4 and 5.

Direct materials and supplies account for more than a third of total sales. Plastics materials range in price from about 12¢ to 75¢ per pound for commonly used virgin materials to as much as $6.00 per pound for specialties, but molders may lower costs by purchasing reprocessed materials. Reprocessed materials may be used where high-quality finish is not required, as in some industrial

Table 3

PROJECTED PROFIT AND LOSS STATEMENT

		Per Cent of Sales
Sales	$300,000	100.0
Direct materials and supplies	105,000	35.0
Direct labor (See Table 2)	43,000	14.3
Other manufacturing expense (See Table 4)	74,600	24.9
Cost of Goods Sold	222,600	74.2
Gross Profit	77,400	25.8
Selling, General, and Administrative Expense (See Table 5)	57,100	19.0
Profit before Taxes	20,300	6.8
Net Profit	15,800	5.3

parts where strength and configuration are more important. Other items included in the $105,000 total for direct materials and supplies are colorants, metal and other parts used in the finished plastics products, and limited amounts of packaging.

Largest variable in Table 4 is the cost of molds, shown as $25,000. Commonly used molds vary in price from $1,000 to $25,000. A single mold can be used to produce more than one product, however, if it is equipped with a variety of interchangeable cores and cavities. The company's balance between custom-molded and proprietary products will largely determine its cost for molds, since the customer rather than the molder generally invests in molds used for custom molding.

Based on the above assumptions, an injection-molding operation in Carroll County of the specified capacity and size should realize a net profit of $15,800, or 5.3%, on an annual sales volume of $300,000.

Table 4

OTHER MANUFACTURING EXPENSE

Indirect Labor		
Production manager-engineer	$11,500	
Shipping-receiving-cost control clerk	4,700	
Maintenance-general utility man	5,000	
Janitor-laborer-maintenance helper	2,400	
		$23,600
Other Labor Costs		
Company payments for Social Security, Workmen's Compensation, and company pension and health plans (both direct and indirect labor)		6,700
Supplies		
Molds	$25,000	
Maintenance materials and repair parts	2,500	
Lubricants, hand tools, other manufacturing supplies	500	
		28,000
Utilities		
Electricity	$ 3,800	
Fuel	500	
Water	1,000	
		5,300
Others		
Depreciation, plant and machinery	$ 9,000	
Outside services (maintenance, repair)	2,000	
		11,000
TOTAL		$74,600

Table 5

SELLING, GENERAL, AND ADMINISTRATIVE EXPENSE

Wages and Salaries		
General manager's salary	$13,500	
Sales engineer's salary and commissions	11,000	
General secretary	2,900	
		$27,400
Others		
Telephone, telegraph, postage	$ 3,000	
Advertising, travel, entertainment	3,500	
Office and equipment depreciation	500	
Stationery and other supplies	1,500	
General insurance (including liability)	3,000	
Interest paid	8,000	
Company payments for Social Security, Workmen's Compensation, and company pension and health plans	2,700	
Bad debts and discounts	3,500	
Outside services, including audits	3,000	
Other taxes (excluding Federal income taxes)	1,000	
		29,700
TOTAL		$57,100

Costs in Tables 3, 4, and 5 are calculated on the basis of the $167,700 total capital requirement indicated in Table 1. Excluding from selling, general, and administrative expense the $8,000 allocated for interest on borrowed capital (Table 5), the over-all return on investment, including the annual profit of $15,800, would be $23,800, or 14.1%. The return would exceed 15% on the alternative investment of $150,000 in which the building is leased or rented instead of purchased.